

# Exhibit I

# Flood Resistant Design and Construction

This document uses both the  
International System of Units (SI)  
and customary units

**Table 2-1 Minimum Elevation of the Top of Lowest Floor—Flood Hazard Areas Other Than Coastal High Hazard Areas,<sup>a</sup> Coastal A Zones,<sup>a</sup> and High Risk Flood Hazard Areas<sup>a</sup>**

Flood Design Class <sup>b</sup>	Minimum Elevation, Relative to Base Flood Elevation (BFE) or Design Flood Elevation (DFE)
1 <sup>c</sup>	DFE
2 <sup>d</sup>	BFE + 1 ft or DFE, whichever is higher
3 <sup>d</sup>	BFE + 1 ft or DFE, whichever is higher
4 <sup>d</sup>	BFE + 2 ft or DFE, or 500-year flood elevation, whichever is higher

<sup>a</sup>Minimum elevations shown in Table 2-1 do not apply to Coastal High Hazard Areas and Coastal A Zones (see Table 4-1). Minimum elevations shown in Table 2-1 apply to other high risk flood hazard areas unless specific elevation requirements are given in Chapter 3 of this standard.

<sup>b</sup>See Table 1-1 for Flood Design Class descriptions.

<sup>c</sup>Flood Design Class 1 structures shall be allowed below the minimum elevation if the structure meets the wet floodproofing requirements of Section 6.3.

<sup>d</sup>For nonresidential buildings and nonresidential portions of mixed-use buildings, the lowest floor shall be allowed below the minimum elevation if the structure meets the dry floodproofing requirements of Section 6.2.

## 2.7 ENCLOSURES BELOW THE DESIGN FLOOD ELEVATION

Enclosed areas that are used solely for parking of vehicles, building access, or storage shall be permitted below the DFE, provided the enclosed areas meet the requirements of this section.

**2.7.1 Required Openings in Foundation Walls and Walls of Enclosures** Foundation walls and exterior walls that form enclosures below the DFE that do not meet the dry-floodproofing requirements of Section 6.2 shall contain openings to allow for automatic entry and exit of floodwaters during design flood conditions. Openings shall meet the requirements of Section 2.7.2 and Section 2.7.3.

**2.7.1.1 Openings in Breakaway Walls** Openings to allow for the automatic entry and exit of floodwaters during design flood conditions shall be installed in breakaway walls in all flood hazard areas. Openings shall meet the requirements of Section 2.7.2 and be installed in accordance with Section 2.7.3.

**2.7.2 Design of Openings** Openings shall meet the non-engineered opening requirements of Section 2.7.2.1 or the engineered opening requirements of Section 2.7.2.2. Installation of all openings shall meet the requirements of Section 2.7.3.

**2.7.2.1 Non-Engineered Openings** Non-engineered openings shall meet the following criteria: (1) The total net open area of all openings shall be at least 1 sq in. for each sq ft of enclosed area, where the enclosed area is measured on the exterior of the enclosure walls; (2) openings shall not be less than 3 in. in any direction in the plane of the wall; and (3) the presence of louvers, blades, screens, and faceplates or other covers and devices shall not block or impede the automatic flow of floodwaters into and out of the enclosed areas and shall be accounted for in the determination of the net open area.

**2.7.2.2 Engineered Openings** Engineered openings shall meet the following criteria:

- Each individual opening shall be designed to allow automatic entry and exit of floodwaters during design flood or lesser flood conditions;
- The performance of engineering openings shall account for the presence of louvers, blades, screens, grilles, faceplates, or other covers and devices;

**Table 2-2 Flood Opening Coefficient of Discharge<sup>a</sup>**

Opening Shape and Condition	c
All shapes, partially obstructed during design flood <sup>b</sup>	0.20
Circular, unobstructed during design flood	0.60
Rectangular, long axis horizontal, short axis vertical, unobstructed during design flood	0.40 <sup>c</sup>
Square, unobstructed during design flood	0.35
Rectangular, short axis horizontal, long axis vertical, unobstructed during design flood	0.25 <sup>d</sup>
Other shapes, unobstructed during design flood	0.30

<sup>a</sup>Different coefficients of discharge shall be permitted: (1) where a designer has performed detailed, opening-specific calculations, a coefficient of discharge up to 10% different than given in Table 2-2 shall be permitted; or (2) where laboratory testing or numerical modeling of flow through the opening has been conducted, the resulting coefficient of discharge shall be permitted. In no case shall a coefficient of discharge >0.60 be permitted.

<sup>b</sup>Openings shall be classified as partially obstructed if louvers, blades, screens, grilles, faceplates, or other covers or devices are present during the design flood.

<sup>c</sup>When the horizontal dimension is twice or more the vertical dimension, use 0.4; as the dimensions approach a square, interpolate from 0.4 to 0.35.

<sup>d</sup>When the horizontal dimension is half or less the vertical dimension, use 0.25; as the dimensions approach a square, interpolate from 0.25 to 0.35.

- Openings shall not be less than 3 in. in any direction in the plane of the wall;
- The performance of engineered openings shall ensure that the difference between the exterior and interior floodwater levels shall not exceed 1 ft;
- In the absence of reliable data on the rates of rise and fall, assume a minimum rate of rise and fall of 5 ft/h; where an analysis indicates the rates of rise and fall are greater than 5 ft/h, the total net area of the required openings shall be increased to account for the higher rates of rise and fall; where an analysis indicates the rates of rise and fall are less than 5 ft/h, the total net area of the required openings shall remain the same or shall be decreased to account for the lower rates of rise and fall; and
- The minimum total net area of the required openings in enclosure walls shall be calculated using the equation

$$A_o = 0.033 (1/c)(R)(A_e)$$

where

$A_o$  = the total net area of openings required (in.<sup>2</sup>)

0.033 = coefficient (in.<sup>2</sup> · h/ft<sup>3</sup>) corresponding to a factor of safety of 5.0

$c$  = opening coefficient of discharge given in Table 2-2

$R$  = worst case rate of rise and fall (ft/h)

$A_e$  = the total enclosed area (ft<sup>2</sup>).

**2.7.3 Installation of Openings** Installation of openings shall meet the following criteria:

- Each enclosed area shall have a minimum of two openings,
- Openings shall be in at least two walls of each enclosed area,
- The bottom of each opening shall be no more than 1 ft above the higher of the final interior grade or floor and the finished exterior grade immediately under each opening, and
- Openings meeting requirements of Section 2.7.2.1 or Section 2.7.2.2 that are installed in doors and windows are permitted.